

REMARKS

By the present amendment, new claims 8-19 have been added. Claim 8 corresponds to claim 4 but depends on claim 2, claims 9-11 correspond to claim 5 but depend on claims 2, 4, and 8, respectively, and claims 12-18 correspond to claim 7 but depend on claims 2, 4, 5, and 8-11, respectively.

Also, new claim 19 has been added to recite that, in the rich-mixture regeneration operating mode, the injection means are suitable for implementing a series of injections consisting of (i) a plurality of pilot injections comprising at least two pilot injections triggered in a crankshaft angle range from approximately 50° to approximately 5° ahead of the top dead centre point of the cylinder concerned and (ii) a single main injection triggered in an undercalibrated range up to a crankshaft angle of approximately 35° after the top dead centre point. Support for claim 19 is found in the original application, in particular on page 4, lines 11-15.

Claims 1-2, 4-5, and 7-19 are pending in the present application.

In the Office Action, claims 1-2, 4, and 7 are rejected under 35 U.S.C. 103(a) as obvious over US 6,901,747 to Tashiro et al. (“Tashiro”) in view of US 6,666,020 to Tonetti et al. (“Tonetti”).

Further, claim 5 is rejected under 35 U.S.C. 103(a) as obvious over Tashiro in view of Tonetti and further in view of US 6,082,325 to Digeser et al. (“Digeser”).

It is alleged in the Office Action that Tashiro discloses standard and regeneration modes for engine loads below a threshold value, as well as a single pilot injection before main injection,

and Tonetti discloses pilot and pre-injection before main injection, so that it would have been obvious to add a pilot injection in the system of Tashiro.

The rejections are respectfully traversed. Tashiro triggers its main injection (Fas, Fam) between 40° and 90° after the top dead center (TDC), not in an undercalibrated range up to a crankshaft angle of approximately 35° after the TDC point, as recited in the presently claimed invention.

Specifically, the difference between an injection which is triggered up to approximately 35° after the TDC, as in the present invention, and an injection which is triggered between 40° and 90° after the TDC, as in Tashiro, will be explained.

A main injection results most of the time in complete burning of the fuel, the energy being transformed into a force that propels the engine. However, an injection that is triggered after the TDC can become analogous to a post-injection. If the injection is late, a portion of the energy is transformed into heat, which increases the temperature of the gases, and if this injection is even later, a portion of the injected hydrocarbons (HC) remains unburned and is evacuated with the exhaust gases. These unburned HC can, in a known manner, be oxidized in an oxidation catalyst during an exothermic reaction, which increases the temperature of the exhaust gases even more. Such an oxidation catalyst is often placed upstream of impregnated on a particle filter (PF). This makes it possible to increase the temperature of the exhaust gases to a level sufficient to regenerate the PF.

In Tashiro, the injections between 40° and 90° after the TDC are designed to assist the regeneration of the PF. In fact, all the embodiments of Tashiro concern the regeneration of a PF

equipped with such an oxidation catalyst. It is noted that Tashiro mentions NO_x catalysts (see Tashiro at the passage bridging cols. 20-21), but Tashiro does not provide any guidance or teaching regarding any modification of its system generally or the timing of a late injection in particular.

Similarly, Tonetti applies only to a PF. Thus, Tonetti does not provide any suggestion or guidance to modify Tashiro, let alone the timing of a late injection.

In summary, Tashiro and Tonetti focus on oxidizing a high amount of unburned HC in an oxidation catalyst during an exothermic reaction in order to increase the temperature of the exhaust gases and reach a level sufficient to regenerate the PF.

In contrast, the present inventors have focused on the regeneration of a storage/release NO_x trap. Thus, the presently claimed invention provides an injection means suitable for implementing at least two pilot injections triggered in a crankshaft angle range from approximately 50° to approximately 5° ahead of the top dead centre point of the cylinder concerned and the main injection is triggered in an undercalibrated range up to a crankshaft angle of approximately 35° after the top dead centre point, as recited in present claim 1. An advantage of this feature is that this can improve the regeneration of the NO_x trap, for example, when the gases passing therethrough have a richness above 1, with a concentration in oxygen that has been reduced effectively, but without necessarily resulting in high amounts of HC, as is likely the case with the late injection as provided in Tashiro and Tonetti for regenerating their particle filter.

This feature of the presently claimed invention and its advantages are not taught or suggested in the cited references. Therefore, the present claims are not obvious over the cited references taken alone or in any combination.

In addition, with respect to the dependent claims, it is submitted that the combined features of these respective claims are not taught or suggested in the cited references.

In particular, with respect to claim 19, it is submitted that, since both Tashiro and Tonetti require a late injection beyond 40° after TDC to regenerate their PF, Tashiro and Tonetti teach away from a NO_x trap regeneration mode with a series of injections consisting of (i) a plurality of pilot injections comprising at least two pilot injections and (ii) a single main injection triggered in an undercalibrated range up to a crankshaft angle of approximately 35° after the top dead centre, as recited in present claim 19. Therefore, claim 19 is not obvious over the cited references taken alone or in any combination.

In view of the above, it is submitted that the rejections should be withdrawn.

In conclusion, the invention as presently claimed is patentable. It is believed that the claims are in allowable condition and a notice to that effect is earnestly requested.

In the event there is, in the Examiner's opinion, any outstanding issue and such issue may be resolved by means of a telephone interview, the Examiner is respectfully requested to contact the undersigned attorney at the telephone number listed below.

Amendment
Serial No. **10/532,229**
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In the event this paper is not considered to be timely filed, the Applicants hereby petition for an appropriate extension of the response period. Please charge the fee for such extension and any other fees which may be required to our Deposit Account No. 502759.

Respectfully submitted,

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